

The Cost of Progress: Accountability and Aftermath of Nuclear Testing in Semipalatinsk

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The Semipalatinsk Test Site (STS), the Soviet Union's main nuclear testing site, remains a reminder of the human and environmental costs of Cold War militarization. This article combines scientific, historical, and political perspectives to examine the creation, exploitation, and long-term consequences of STS from an interdisciplinary perspective. The STS serves as an example of how scientific ambitions and the struggle for geopolitical control have neglected the rights and health of local people, creating a legacy of long-term pollution, disease, and socio-environmental injustice. The site still poses danger for public health and land use, which reflects larger conflicts between environmental justice and post-Soviet development.

Keywords: Kazakhstan; Semipalatinsk Test Site; nuclear testing; nuclear contamination; Olzhas Suleimenov; civil resistance; anti-nuclear movement; Cold War

The Semipalatinsk Test Site (STS) is one of the most prominent symbols of the nuclear age, a massive Soviet project that not only turned the Kazakh steppe into a testing ground for Cold War experiments, but also left a lasting legacy of environmental, political, societal, and human consequences. This article explores the origins, exploitation, and aftermath of the STS, including the Nevada-Semipalatinsk anti-nuclear movement and the ongoing fight for recognition and rehabilitation in post-Soviet Kazakhstan.

The history of nuclear physics has been extensively researched, ranging from the groundbreaking work of Dalton, Rutherford, and Einstein to the Manhattan Project and related Soviet initiatives (Fergusson 2011, 147; Niaz 2009, 4). The majority of these historical accounts concentrate on either state-level decisions or technical aspects. The Soviet nuclear weapons race during the Cold War and institutional history were detailed in the foundational works of Zuberi (1999) and Yemelyanov and Holloway (1987). The long-term impacts of nuclear testing on local ecosystem and human health have been explored by the ecological research of Bauer and Penter (2022) and the public health assessment of Grosche et al. (2011) and Land et al. (2015). Despite this rich body of scholarship, a comprehensive and interdisciplinary analysis that covers the scientific, social, and political aspects of the Semipalatinsk legacy remains limited.

This essay combines a historical narrative with scientific evidence, political analysis, and the historiography of protest to show that Semipalatinsk is a site of ongoing struggles for development, justice, and memory, rather than a simple memorial of the Cold War. The main focus of this article is how the test site affected the land and its inhabitants as well as Kazakhstan's path to environmental sovereignty and national identity, analysing the transition from scientific discoveries to state violence and, ultimately, civil resistance.

The essay is organized as follows. The first section provides an overview of the geopolitical environment and scientific foundations that resulted in the STS creation. Its exploitation during the Soviet nuclear weapons program is examined in the second section, as well as important tests and their results. Further, the Nevada-Semipalatinsk movement is described in the third section, emphasizing its national nature by situating it within international cultures of protest. Finally, drawing on recent scientific findings regarding soil, water, animal and human contamination, section four assesses the environmental and health impacts of testing. Conclusion considers the long-term significance of STS as a representation of both resistance and degradation.

Creation of STS

The STS was created in the early 1940s. After noticing progress made by western scientists, namely during the Manhattan Project, the Soviet government decided in 1942 to start their own research on atomic energy. Joseph Stalin passed a secret disposition №2352 “On the organization of work on uranium” and in 1943 Molotov, prime minister of USSR, assigned most reliable physicists (one of them was Igor Kurchatov) for the project on creating a nuclear bomb (Zuberi 1999, 1135). For that purpose, a new facility - Laboratory Number Two - was created in Moscow with Kurchatov as a director (Yemelyanov and Holloway 1987, 39). In 1945, the construction of *Mayak* (*lighthouse*) began, “the largest site of nuclear processing, the plutonium production facility” (Bauer and Penter 2022, 3), nuclear programs were institutionalized.

Later on, in 1947, Lavrentiy Beria, the First Deputy Premier of the Soviet Union and a head of the atomic bomb project, selected the future Semipalatinsk Test Site in the steppe area of northeast Kazakhstan and building began. It was situated on the left bank of the Irtysh River, roughly 130 kilometres northwest of Semipalatinsk City - this place was selected due to its minimal population and isolation, which allowed for secrecy (Dabrowski 2021, 4). During that time, the construction of Mayak was finished and Kurchatov himself “produced a sustained chain reaction on June 10, 1948” (Yemelyanov and Holloway 1987, 39), which meant that the first weapon-oriented atomic reactor in the USSR and Europe was created. A year later, at STS, “at the command of Lavrentii Beria . . . the first Soviet nuclear bomb (22 kt TNT eq.) was detonated at the test site, under vast political pressure, during unfavourable weather conditions” (Bauer and Penter 2022, 199).

Activity and Exploitation of STS

The first nuclear bomb test was conducted in 1949 and since then hundreds of such tests have taken place, which were called “RDS” (the meaning of abbreviation is still unknown, the only definition known is “*reaktivny dvigatel specialny*” or “jet engine special”) and an according number next to it. Before describing the tests performed in STS, it is worth mentioning how bombs were delivered to it. After mining, uranium was sent and processed at facilities such as Mayak and also underwent testing at nuclear facilities. Finally, “enriched uranium and plutonium from these facilities were then, after warhead design and assembly in Arzamas-16, brought to the nuclear test sites ... where they were “tested” and detonated” (Bauer and Penter 2022, 4). In particular, all tests ever conducted in

USSR (including STS) are presented in a book “USSR Nuclear Weapons Tests and Peaceful Nuclear Explosions” by Andryshin et al. (1996) and another book by Dabrowski (2021), who takes into an account a period from 1949 to 1962, thoroughly describing every test during that time.

For example, the first test on 29 August 1949 was conducted on the surface (Andryshin et al. 1996, 4) but the next step was to actually test a nuclear bomb from a bomber plane, as it was empirically demonstrated (i.e. during Japan bombing, 1945) that an aircraft and its crew could survive a nuclear blast. Thus, the first air-dropped bomb (RDS-3) was tested on 18 October 1951 in STS, which was a remarkable start for future development not only for bombs, but also for planes that could carry them. Then the first Soviet thermonuclear weapon (RDS-6) was successfully tested in STS in 1953. However, not all tests were successful. On 19 October 1954 during an on-surface test of RDS-9 the nuclear charge failed, and no explosion occurred, but territory was contaminated regardless. A year later, the highest yield nuclear explosion (4 times more powerful than RDS-3) occurred during the test of RDS-37, first Soviet hydrogen bomb, on 22 November 1955 (Andryshin et al. 1996, 12). After that, many tests were conducted but there were periods of suspending nuclear testing, for example in 1959-1961, due to the “moratorium on nuclear testing with the USA and Great Britain” (Andryshin et al. 1996, 9).

After that, in 1961, many tests were “pioneering” - first Soviet underground nuclear test in STS, first Soviet space explosion, and, of course, the highest yield Soviet test (not in STS) of “Tsar Bomba” (AN602 or RDS-202). Eventually, “on 5 August 1963, the Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water was signed in Moscow by the United States, the Soviet Union and the United Kingdom” (Dabrowski 2021, 39), leaving only possible nuclear tests conducted in underground and STS was a perfect facility for that. After hundreds of other tests, the last one in STS was conducted on 19 October 1989 and the site was officially closed in 1991 after Kazakhstan gained independence. Thus, as Bauer and Penter (2022) conclude, “18 nuclear weapons testing amounted to an official total of 456 nuclear detonations between 1949 and 1989, according to numbers published by Russian authorities” (199). Of course, these tests could not have gone without consequences.

Nevada-Semipalatinsk Protests

The Nevada-Semipalatinsk Anti-Nuclear Movement (NSAM) emerged as one of the most significant protest campaigns of the late Soviet period, particularly in Kazakhstan, where the Semipalatinsk nuclear test site became a symbol of environmental degradation, human suffering, and colonial injustice. Founded in February 1989 following a radioactive gas leak at the Semipalatinsk test site, NSAM was sparked by a public statement by renowned Kazakh poet and public figure Olzhas Suleimenov (b. 1936), who called for an urgent meeting at the Writers' Union in Almaty (Toptayeva 2018, 57). This call led to the creation of the largest grassroots movement in the history of the Kazakh SSR. Unlike spontaneous uprisings, the movement was a strategic political response that combined activism with national identity and electoral politics (Toptayeva 2018, 11). The protests were not merely symbolic in nature – radiation exposure was a daily reality for the residents of Semipalatinsk, whose lives were changed forever by four decades of nuclear testing.

While similar protests occurred around the world, such as the Nevada Desert Experience (NDE) in the United States, NSAM distinguished itself by institutional approach and active social and government involvement. While NDE emphasized individual moral and religious arguments, NSAM mobilized scientific evidence, state commissions, and legislative channels to explore “public health and environmental concerns” unfolding in Kazakhstan (Toptayeva 2018, 26). Eventually, a public healthcare commission confirmed that long-term nuclear testing had a “chronic psycho-traumatic factor affecting the psychological health of the population” (Toptayeva 2018, 62), and severely damaged local environment, so the only possible solution was to stop the exploitation of STS. These findings, spread widely through regional newspapers and scientific conferences, reinforced the movement’s core message: the Semipalatinsk test site was not only a local tragedy, but also a crime against humanity.

Important to note, the protests in Semipalatinsk reflected deeper tensions in the late Soviet period - activists and journalists considered the test site an extension of “Russian imperialism and Moscow’s Cold War technoscientific agenda in Central Asia” (Bauer and Penter 2022, 201). Nuclear testing was sometimes described as “genetic genocide,” linking environmental destruction to the longer arc of colonial subjugation and forced modernization. Even though the immediate closing of the test site was an impossible task at first, Nursultan Nazarbayev intended on solving small problems like fixing wells and decreasing the number of tests to reduce the damage dealt by STS activity

(Toptayeva 2018, 60). The eventual closure of the site on August 29, 1991, as Toptayeva (2018) noticed, “40 years after the first atmospheric testing” (2), became a landmark victory, not just for Kazakh environmentalists but for the nation’s independence movement. This achievement, occurring just months before Kazakhstan declared its sovereignty, symbolized a break from Moscow’s violent legacy and the dawn of a new national consciousness. As Bauer and Penter (2022) note, the closure of Semipalatinsk was “a highly symbolic and significant act” (200), closely related to Kazakhstan’s persuasion of independence and its rejection of Cold War militarism.

However, despite the movement’s success, several problems remained in post-Soviet Kazakhstan. For example, the “Law on the Social Protection of Citizens Exposed due to Nuclear Tests at the Semipalatinsk Nuclear Test Site”, passed in December 1992, promised compensation and social protection for victims of nuclear exposure (Bauer and Penter 2022, 156), but its implementation was delayed for several years by economic hardships. The legacy of Semipalatinsk continued to shape Kazakhstan’s politics, memory, and identity. NSAM demonstrated that organized civil resistance - when rooted in national trauma, supported by government, and amplified by authoritative scientists - could challenge even the most entrenched structures of state violence. Finally, the Semipalatinsk affair was not simply the closure of a test site - it was a collective reckoning with the cost of empire, the price of progress, and the power of protest.

Aftermath

The aftermath of the Semipalatinsk test site’s exploitation is an important topic to explore. The need for contamination assessment was the initiative took up even before the Kazakhstan’s independence - various nuclear waste incidents, the Chernobyl disaster in 1986, contamination of Chelyabinsk region (Russia) and Semipalatinsk region - all these events motivated environmental activists from many regions to examine the consequences of nuclear tests (Bauer and Penter 2022, 1). In particular, in Kazakhstan, “radiation exposure is increased over an area of 350,000 square kilometres (one-tenth of the country’s total area) with a population of over one million” (Bauer and Penter 2022, 155). Not only underground explosions served as highly contaminating tests, but also atmospheric ones, conducted from 1949 until 1963, which led to local and even global contamination. According to recent studies, the Semipalatinsk region remains heavily contaminated with radionuclides such as ^{90}Sr , ^{137}Cs , $^{239-240}\text{Pu}$ and ^{241}Am , particularly in soil and plants (Pravaliyev 2014, 736).

In addition, local water sources also show uranium levels that exceed WHO safety standards. For example, Ground Zero and Lake Balapan are the most affected sites, while significant contamination has also been detected in the Tel'kem and Sary-Uzan areas. Further research has shown that Chinese nuclear tests at Lop Nur, which were conducted from 1964 to 1981, contributed to the radioactive contamination of southern Semipalatinsk in addition to Soviet tests (Yamamoto et al. 2004, as cited in Pravalie 2014, 736). So, radioactive dust from these tests at Lop Nur is believed to be linked to increased cancer rates among the local population. However, as Nazarbayev claimed in 2013, "the territory of the testing site can already be put to use. Scientists, both Kazakhstani and Russian, say there is no radiation, and the lands can be used.... [L]ets make them part of our economy again and use them to our advantage" (Stawkowski 2017, 423). In order to assess these claims, I conducted an analysis of trustworthy sources on examination of contaminated areas of the Semipalatinsk region with regard to soil, water, animals, and people.

To ease the understanding of the analysis, I provide a decoding of main chemical elements that will be used from now on: 3H - Tritium, 131I - Iodine 131, 14C - Carbon 14, 54Mn - Manganese 54, 55Fe - Iron 55, 89Sr - Strontium 89, 90Sr - Strontium 90, 91Y - Yttrium 91, 95Zr - Zirconium 95, 103Ru - Ruthenium 103, 106Ru - Ruthenium 106, 125Sb - Antimony 125, 137Cs - Caesium 137, 140Ba - Barium 140, 141Ce - Cerium 141, 144Ce - Cerium 144, 239Pu - Plutonium 239, 240Pu - Plutonium 240, 241Pu - Plutonium 241, 241Am - Americium 241, U - Uranium (IAEA 1998, 11).

Soil and Plants

Long after nuclear testing was stopped, radioactive contamination from the Semipalatinsk test site exploitation is still present in soil and plants, revealing the legacy of Soviet ambitions during the Cold War. The diverse nature of radioactive contamination at the STS, particularly at the explosion epicentres, is highlighted by recent studies. For example, four distinct species of radioactive particles were detected in soils and sediments by Lukashenko et al. (2020, 18): (1) vitrified spherical particles with transuranic element-rich surfaces and internal porosity, (2) irregular debris-like particles from device-soil interactions, (3) visually unaltered soil particles with actinide inclusions, and (4) amorphous particles in river sediments from the Degelen tunnels. In contrast to 90Sr, which was more mobile and exhibited a range of behaviours, most of these particles contained isotopes such as "137Cs, 241Am, 239-240Pu in soils were strongly associated with solid phases (90–99%)"

(Lukashenko et al. 2020, 18). These results are important because they demonstrate how radionuclides migrate and are retained over time in soils and sediments that are near water, highlighting the need for more thorough monitoring of contamination levels, particles behavior, and land use strategies.

Indeed, numerous studies have shown that soil, especially near test sites and research facilities, contains hazardous radionuclides, in particular aforementioned ^{90}Sr , ^{137}Cs , ^{241}Am and $^{239-240}\text{Pu}$ (Taira et al. 2013; Larionova et al. 2024a, 2024b; Kozhakhanov et al. 2024; Panitskiy et al. 2023b). The surface layer is the main area of concern from an agricultural perspective, since these radionuclides tend to remain concentrated in the upper soil layer (mainly the first 5 cm) and penetrate slightly deeper into the ground in less concentrations (Panitskiy et al. 2023b, 6). In particular, according to Kozhakhanov et al. (2024, 5), the radionuclides tend to spread from soil to plant in a following pattern – leaves tend to have the highest contamination levels, followed by branches and fruits. This bioaccumulation still poses a risk to people dependent on local food sources, representing an enduring challenge for Kazakhstan's environment.

Aside from mentioned nucleotides, another isotope like tritium (^3H) was detected in soil and plants near the boreholes at the Sary-Uzen site. In some locations, organically bound tritium (OBT) levels reached maximum of 200,000 Bq/kg, indicating significant ongoing soil contamination (Larionova et al. 2024a, 6). Moreover, tritium can be taken up by plant leaves when it is released into the atmosphere as vapor (tritiated water, HTO), particularly in environments with high light and humidity levels. Polivkina et al. (2024, 14) warn that there is potential for internal exposure through food consumption, as some of this tritium is still bound in organic plant tissues.

Moreover, not only Semipalatinsk territory was contaminated by the activity of STS, but also nearby regions. For example, high concentrations of plutonium isotopes were detected in studies conducted in northern and northwestern China. Isotopic ratios and inventory data indicate that some of this contamination likely originated from Semipalatinsk and was transported eastward by prevailing winds (Zhao et al. 2020, 8; Feng et al. 2023, 8). These results highlight the need for long-term monitoring across the region and reveal the broader environmental impacts of STS, which challenges the notion of Semipalatinsk as a local problem and underlines the global consequences of nuclear testing.

All of this highlights why long-term monitoring of the soil and plants in the STS area is so important, demonstrating how its environmental legacy is immediate and far-reaching. Assessing the contamination helps us to understand the risks and plan safe ways to use the land, especially if people are growing food there or are engaged in cattle breeding, thus highlighting the importance of maintaining environmental safety and public health, as well as improving regional diplomacy and national land policies.

Water

In addition to soil and plants, artificial radionuclides and other toxic elements continue to impact drinking water, groundwater, rivers, and lakes at the STS, making water pollution a serious environmental issue and amplifying environmental injustice across Central Asia. In particular, nucleotides like ^{90}Sr and ^3H were detected in rivers and streams throughout the site, especially in areas near underground nuclear test sites such as "Degelen" (Karabulak Creek, Shagan River) and "Balapan" (Timonova et al. 2024, 16; Dyussembayeva et al. 2025, 14). Increased concentrations of these radionuclides were associated with water leakage from nuclear test tunnels in Karabulak Creek. Additionally, the water was not appropriate for domestic or agricultural use due to very high concentrations of heavy metals such as uranium, beryllium, and iron (Dyussembayeva et al. 2025, 12). Moreover, according to Krasnopyorova et al. (2023, 29361) study on the Semipalatinsk drinking water sources, numerous locations along the Karabulak and Uzynbulak streams were contaminated with artificial radionuclides and, therefore, were declared unfit for use as water supplies.

With the exception of the confluence with the Shagan River (where tritium was detected continuously throughout the year) the Irtysh River, an important transboundary water body, was more or less within safe limits further downstream. In addition, as stated by Aidarkhanova et al. (2024, 26216), levels of iron, water hardness, and chlorides were measured and exceeding permissible limits have been recorded in the vicinity of Ust-Kamenogorsk, which indicates industrial and radioactive emissions into the river system and highlighting the need for continuous monitoring. The contamination of groundwater, on the other hand, is more localized; wells close to the Atomic Lake and the Shagan River have been found to contain high tritium levels of up to 95,000 Bq/L (Aktayev et al. 2024, 12). However, as Aktayev et al. (2024, 12) conclude, "the source of pollution in

these areas is associated with the influence of the river Shagan, which washes out tritium when filtered through the ‘Atomic Lake’ funnel”.

Finally, at STS, radioactive contamination is also present in natural lakes, particularly in sediments. In some lakes (considered as exceptions), ^{90}Sr levels in water were higher than in sediments, despite their typically high concentrations of radionuclides. Moreover, as Aidarkhanova et al. (2022, 6) points out, some plants, such as tamarisk (*Tamarix ramosissima*) and saltwort (*Salicornia europaea*), can accumulate large amounts of ^{90}Sr and ^{137}Cs suggesting that they could be used as indicators of contamination. Nevertheless, lakes that are not located in the area of test site do not pose a threat and potentially can be used as water sources.

Thus, the available evidence suggests that waterborne radioactive exposure is not just historical, but ongoing and poorly controlled, continuing to impact the local environment. This risk becomes not only ecological, but also socio-political, especially when combined with the lack of access to drinking water. This means that STS is not only an ecological hazard, but also a structural inequity, where political and scientific neglect merge.

Animals

After considering soil, plants and water, it is worth analysing living things, animals and people who consume the grown plants and water. Studies on hoofed animals inhabiting the STS territory show that while these animals are exposed to radioactive contamination in the environment, their meat and milk generally remain within safe consumption limits—at least for standardized radionuclides like ^{137}Cs and ^{90}Sr . Panitskiy et al. (2023a, 14) evaluated farm animals such as cows, goats, sheep, and horses, as well as wild species like moose, saigas, roe deer, and argali, and found no exceedances of regulatory thresholds for ^{137}Cs and ^{90}Sr in meat or dairy products under natural grazing conditions. Unstandardized radionuclides such as ^{241}Am and $^{239+240}\text{Pu}$ were also detected in trace amounts, especially in wild species, but were not hazardous. Activity concentrations of ^{90}Sr and ^{137}Cs in wild animals such as roe deer varied greatly between organs and tissues. Bones accumulated the most ^{90}Sr , which is consistent with its calcium-mimicking behavior, whereas muscle tissue held comparatively low levels (Panitskiy et al. 2024, 5).

Tritium was detected in two forms in the roe deer study conducted in the Degelen test area: HTO (free water) and OBT (organically bound tritium). Tritium concentrations did not show

equilibrium and varied between organs, indicating uneven intake depending on environmental exposure. Importantly, the ratio of OBT to HTO indicated the length of time an animal had been in contaminated areas – higher ratios suggested longer presence (Panitskiy et al. 2024, 8). These results are critical for reducing radiophobia in nearby communities, as well as for assessing the health risks to people who may consume animals' meat. To better understand the long-term environmental impacts and ensure food safety in the area, the researchers recommend that future studies continue to monitor radionuclide levels in wildlife populations using non-lethal sampling methods.

People

Finally, it is important to assess the aftermath of STS activity on people living in Semipalatinsk region and in nearby areas, as they are exposed by consuming water, plants, and animals' products located there. Long-term health studies of populations exposed to nuclear tests at the STS have found persistent risks associated with cardiovascular disease, thyroid dysfunction, cytogenetic instability, and systemic comorbidities. These are not just biological facts, but indicators of a lack of accountability that require recognition in terms of public health and unresolved issues inherited from Cold War secrecy.

Grosche et al. (2011, 663) found no statistically significant dose-response relationship for cardiovascular mortality in their analysis of the Semipalatinsk historical cohort. However, residents who lived closer to the test site had higher rates of cardiovascular disease and stroke mortality, especially at a young age. These findings were confirmed by Sarkulova et al. (2024, 62), who found that exposed individuals had higher rates and more severe cases of hypertension, coronary heart disease, and cerebrovascular disorders. They were often associated with obesity, metabolic syndrome, and thyroid dysfunction, suggesting that the long-term vascular and endocrine system damage may be associated with long-term low-dose radiation exposure.

In this context, thyroid health has been studied extensively. Even at moderate levels of exposure, Land et al. (2008, 380) found a significant correlation between the prevalence of thyroid nodules detected by ultrasound and the radiation dose associated with fallout. Seven years later, Land et al. (2015) found that “the dose response estimated with the Bayesian method for internal exposures (in males and in males and females combined) is higher than reported in the 2008 analysis” (171). Moreover, study of Drozdovitch et al. (2010, 97), showed that internal exposure – especially

through consumption of locally contaminated dairy products and vegetables – played a significant role in the accumulation of ^{131}I and increasing thyroid radiation dose between 1949 and 1962.

At the cytogenetic level, Kenzhina et al. (2022, 6) found that while background frequencies of chromosomal aberrations were quite low throughout Kazakhstan, they were elevated in the western regions exposed to industrial activity. Cherednichenko et al. (2022, 6), on the other hand, found that residents of Dolon, a highly exposed village, varied significantly in chromosomal aberrations and radiosensitivity. These results highlight the importance of considering biological variability when assessing the long-term effects of radiation exposure, which were shaped by family habits, geography, and government neglect.

Finally, in addition to scientific concerns, local policies and expertise are also important. As Stawkowski (2017, 433) notes, communities like Koyan still rely on coal, meat, and dairy products harvested from contaminated lands. Many areas remain poorly monitored (mainly because of its expensiveness) and local experts worry about “radiophobia”, a collective psychological trauma fuelled by mistrust and uncertainty, despite efforts by the Institute for Radiation Safety and Ecology (IRSE) to reassure the public of current safety conditions. Managing the site’s legacy is complicated because of unclear regulatory framework that prohibits agriculture but allows mining. Interviews with IRSE scientists indicate that the uneven distribution of plutonium and its potentially long-term migration into the environment continue to pose significant challenges. Thus, this striking contradiction where agriculture remains illegal, unlike mining, which still affects people using radioactive coal, in addition to the lack of monitoring leads to “radiophobia”, which becomes not an irrational fear, but a form of trauma rooted in broken trust.

Overall, these studies offer a complex picture of how STS exposure affects human health over time. However, epidemiology alone is insufficient to comprehend the cost of STS activities for human health. It requires a further examination of ways in which nuclear ambition diminished human life, particularly in colonized and peripheral areas. After living not in ignorance but in unawareness during the testing, the people of Kazakhstan deserve transparency, care, and justice.

Conclusion

The Semipalatinsk Test Site serves as a reminder of the profound and long-lasting consequences of choices made for the sake of development. This isolated region of Kazakhstan has seen hundreds of

nuclear explosions over more than 40 years, leaving behind not only radiation but a complex legacy of environmental damage, health problems, and public mistrust. Even today, long after the last test in 1989, the soil, water, plants, animals, and even people still bear the consequences of those experiments. As Luksashenko et al. (2020) highlight, “from 1997 to present, the General Assembly of the United Nations (UNGA) has adopted 9 resolutions on international cooperation and coordination for the restoration of the environment and rehabilitation of the population in the Semipalatinsk region” (3), which shows a serious concern about the aftermath of STS activity.

Scientific research has shown that radioactive elements such as plutonium, caesium, and strontium remain in the ground and sometimes enter the food chain. While some parts of the land may now be considered “safe”, not all nearby residents feel that way. This exposure adds a layer of uncertainty and anxiety to the lives of many locals who still use the land to collect fuel and food, sometimes because they have no other choice. The fact that mining is permitted in some places while farming is prohibited in others raises even more concerns about risk and fairness. What makes STS’s narrative so compelling and moving is that it is about people, not just radiation levels or test dates. The consequences of what was done in their backyard are still felt by people who never asked for it. STS requires more than just rehabilitation – it requires accountability.

Thus, STS stands as a living example of unresolved national trauma, environmental injustice, and contested memory. But it also offers a chance for Kazakhstan, and the world, to do things differently: to listen to science, to listen to people, and to make choices that put safety, honesty, and healing at the center of policy and progress. It is now our responsibility to listen, to learn, and to ensure that neither the consequences nor the people who lived through them are ever forgotten.

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